Pheasant. I used to trap a good many up in Penungah, but I never saw one except those I caught. They were very plentiful, but they lie very close and seldom or never fly. I obtained them on steep hill-sides, and have never found one on any low-lying or flat ground. They are very pugnacious, and their heads are consequently often raw and scarred, while they would attack any other birds put in their cages. I do not know what they live on, but they thrive well in captivity on *padi*, boiled rice, and fruit. They roost in trees, and climb to their roost instead of flying. The hen bird has no resemblance to the cock, being more like the female of our common European Pheasant, though larger; it was consequently supposed to be a distinct species, and was described as such by Mr. Sharpe under the name of *Lobiophasis castanei-caudatus*. I never could keep any of the hens alive, as they refused food and seemed to mope, and would die in about two days. I am sorry I cannot give you any better information about them, but I could only gather such facts as I was able to observe myself."

The Dyaks say when a Bulwer's Pheasant flies a flood is coming.

XLIII.—*An Attempt to Diagnose the Suborders of the Great Gallino-Gralline Group of Birds by the aid of Osteological Characters alone.* By HENRY SEEBOHM.

MANY opinions have been expressed, in 'The Ibis' and elsewhere, as to the new system which must replace the now discarded Cuvierian classification of birds; and occasionally, as in Professor Huxley's celebrated paper on the taxonomic value of the modifications of certain of the cranial bones, the reasons upon which the opinions were based have been given.

I propose in the present paper to record certain facts in the osteology of the Charadriidæ and their nearest allies, which facts possess at least this value—a knowledge of them enables the student to diagnose the various suborders. These suborders may or may not be natural groups, expressing the mutual relationship of the birds contained in them; but we have every reason to believe that they are approximately so.

There can be little doubt that the osteological characters of birds are a much safer guide to their natural affinities than the external characters which are to be discovered by an examination of the bill and the feet, or the wings and the tail, and which consequently are founded more upon modifications of skin than modifications of bone. Other departments of anatomy may be more important than osteology, but next to the skin and feathers the skeleton is the easiest to obtain; so much so, indeed, that of a great many species of birds the osteology is the only part of the anatomy of which anything is known.

Articulation of the Dorsal Vertebræ.

It has recently been shown (Parker, Proc. Roy. Soc. xliii. p. 470) that other birds besides the Penguins and Auks are opisthocœlous (or post-concave) in the articulation of their dorsal vertebræ. We are assured that the Limicolæ, Gaviæ, *Phalacrocorax*, *Plotus*, *Steatornis*, and the Psittacidæ are opisthocœlous, and that it is the more common kind of articulation in Archaic reptiles. It would, however, be a mistake to assume that the Impennes and the Gavio-Limicolæ, because they have opisthocœlous dorsal vertebræ, are more nearly related to each other than the latter are to some of the groups which have heterocœlous (or saddle-shaped) dorsal vertebræ. The fact is, that every intermediate form between one and the other occurs in the Gavio-Limicolæ—so much so, indeed, that the dorsal vertebræ of *Numenius arquata*, for example, more nearly resemble in their articulation the dorsal vertebræ of the Gallinæ than those of the Impennes. The last free vertebra of *Spheniscus demersus* is anteriorly convex and posteriorly concave, both in its lateral and vertical sections. That of *Argus giganteus* is the same in its vertical section, but exactly the opposite in its lateral section. That of *Numenius arquata* agrees with both in having the posterior outline of the vertical section concave, is intermediate between the two in having the posterior outline of the lateral section straight, and differs from both in having the anterior outline of the vertical section straight, whilst in the anterior outline of the lateral section it agrees with the Pheasant and not with the Penguin. In order to make the term opisthocœlous cover the articulation of the dorsal vertebræ of the Impennes and the Gavio-Limicolæ, and exclude that of the other suborders, it must be artificially defined as follows:—Opisthocœlous vertebræ are, posteriorly, either straight or concave (not convex) when seen in lateral section. As thus understood (its taxonomic importance reduced to a minimum), opisthocœlism becomes a useful character for diagnostic purposes. Two facts in connexion with this character are important: typically heterocœlous dorsal vertebræ may or may not be ankylosed together, and may or may not have deep lateral depressions; opisthocœlous dorsal vertebræ are never ankylosed together, and always have deep lateral depressions.

Ankylosis of the Dorsal Vertebræ.

The sacrum is composed of ankylosed vertebræ, in front of which is a free dorsal vertebra. Four completely ankylosed dorsal vertebræ precede this free dorsal vertebra in the Columbæ, the Pterocletes, the Crypturi, the Gallinæ, and the Podicipes; but, as usual, the character breaks down in one group. In the Grallæ, *Rhinochetus* and *Opisthocomus* are typically Galline in this respect; *Psophia* and some species of *Grus* and *Otis* are partially so; whilst in most species all the vertebræ in front of the ankylosed sacral vertebræ are free.

Ventral Processes of the Dorsal Vertebræ.

In Birds each dorsal vertebra is furnished with three, and sometimes with four, prominent processes. Above the neural canal is the neural spine, and on each side of it is a transverse process (diapophysis) which articulates with the shoulder (tuberculium) of the rib on each side. Below the neural canal is the centrum, each end of which articulates with the adjoining vertebræ in the different modes already described. At the bottom of the centrum, that is to say opposite the neural spine, a ventral process (the hypapophysis) frequently occurs.

The number of rib-bearing vertebræ which are unfurnished with ventral processes vary very much in the group of birds under consideration. It is greatest in the Rallidæ and Gruidæ (6 to 7) and in *Thinocorus* (7). In the Laridæ and Charadriidæ the usual number is 5 (as it is also in the Otididæ), but in some of the Alcidæ it is only 2. In the Cracidæ it varies from 3 to 4, as it does also in the Turnicidæ and the Pteroclidæ. It is smallest in the Gallinæ, the Impennes, the Crypturi, and the Colymbidæ, and in most of the Tubinares (0 to 2). In the last-mentioned suborder the number is 4 in *Oceanites* and *Diomedea*.

Median Processes of the Furculum.

At the junction of the two halves of the furculum (or merrythought) a median process (the hypocleidium or interclavicle) is frequently developed. In the remarkable bird *Opisthocomus* it forms a long bone uniting the furculum with the sternum. In the Cracidæ it is much prolonged, and it is well developed and usually laterally flattened in all the Gallinæ. In all the other suborders under consideration it is either very small or absent.

Pneumaticity of the Humerus.

I am inclined to agree, to a certain extent, with Professor Huxley in his assertion (Proc. Zool. Soc. 1868, p. 296) that the pneumaticity or otherwise of certain bones of birds is a character of no systematic value, though the isolated case to which he refers is not a case in point. Prof. Parker has since discovered that the statement that the Cracidæ differ from the Megapodidæ in this respect was an error. No osteological character appears to be constant in every group, and I do not know that the character in question is much more erratic than others which are admitted to be of some taxonomic importance.

Pneumatic humeri appear to be constant in the Gallinæ, the Pterocletes, the Columbæ, and the Crypturi. The humerus appears to be always oily in the Colymbæ, the Podicipes, and the Impennes. The Tubinares appear to have oily humeri, with the exception of the Diomedeidæ; and so have the Gavio-Limicolæ, with the exception of three genera, *Stercorarius, Rhynchops,* and *Anous.* In the Grallæ the only exceptions that I know of are the Gruidæ, the Otididæ, *Opisthocomus,* and possibly *Psophia.*

Subclavicular Process.

The coracoid articulates not far from one end with the end of the scapula, and at the end with the side of the clavicle near its end. The end of the scapula also articulates with the end of the clavicle, and the end of the clavicle is generally also articulated with a process which springs from near the end of the coracoid. This process is called the subclavicular process; it is absent in the Ratitæ, the Crypturi, and the Gallinæ.

Bifurcation of the Nasal Bone.

The bifurcation of the nasal bone where it joins the frontal and becomes separated into two processes, one (the superior or inner process) coalescing with the nasal process of the præmaxillary, and the other (the inferior or outer process) joining the maxillary, varies in different species of birds. In the Plovers the angle of bifurcation is as acute as possible, and the apex extends as far as the posterior terminations of the nasal processes of the præmaxillary between the centres of the lachrymals. Garrod regarded this character as of great importance in the classification of birds, and proposed to term birds possessing it *schizorhinal* (Garrod, Proc. Zool. Soc. 1873, p. 33). In most birds this angle of the bifurcation of the nasal is rounded off, and a line drawn across the skull at a tangent to the two curves falls in front of the lachrymals and the termination of the nasal processes of the præmaxillary. To this character Garrod applied the term *holorhinal*; but it is doubtful whether it has the taxonomic importance which he at first supposed it to possess, inasmuch as some birds are intermediate. The character consists of two parts, one relating to the length of the nasal aperture, the other to its shape. Some genera, of which *Cursorius* and *Glareola* are examples, are schizorhinal in respect of the length of the nasal aperture, but holorhinal in respect of its shape. These birds were regarded by Garrod as schizorhinal.

This character appears to be constant in Columbæ, Pterocletes, Crypturi, Gallinæ, Podicipes, Colymbi, Tubinares, and Impennes, but it breaks down in the Gaviæ and the Grallæ.

The typical Gruidæ are schizorhinal, but the Rallidæ are holorhinal. The typical Gruidæ have a long narrow sternum with no xiphoid processes; but the Rallidæ have long external xiphoid processes, separated by a deep notch from the median xiphoid process, and considerably prolonged beyond it. The genus *Psophia* is Ralline in the bifurcation of the nasals, but Gruine in the shape of its sternum. It is also Gruine and not Ralline in the extent to which its dorsal vertebræ are ankylosed; but it is Ralline, and not Gruine, in having, when adult, no lateral occipital fontanelles.

Lateral Occipital Fontanelles.

In addition to the *foramen magnum* many birds have *lateral fontanelles* in the occipital bone. It is not known that these lateral fontanelles serve any special purpose, unless economy of bone be regarded as such; but in some cases they are very useful as aids to classification. For example, they are present in the Charadriidæ and absent in the Parridæ, which otherwise agree in being schizorhinal and in having basipterygoid processes. They are present in the Alcidæ and absent in the adult Laridæ, which also agree in being schizorhinal, but are without basipterygoid processes.

But, like all other osteological characters, the presence or absence of lateral occipital fontanelles is a most unsafe guide to the classification of birds. Although they are normally present in the Charadriidæ, they are frequently completely ossified, in some species (*Totanus pugnax*, for example) more frequently than in others. On the other hand, although there are no traces of these fontanelles in the Laridæ when adult, they are found in these birds whilst they are in an embryonic condition, and in some genera (*Chionis*, for example) they do not completely ossify until advanced age.

Basipterygoid Processes.

The presence of basipterygoid processes on the basisphenoid which articulate with facets on the pterygoids is a very archaic character. They are suppressed in the embryos of many Passerine birds, but are present in all others. In all Passerine birds, and in half the remainder, they are absorbed before the bird becomes adult; but in the other half of the non-Passerine birds, and in all the Ratitæ, they are always present. They also occur in the lizards and some of the snakes.

The position of the basipterygoid processes varies considerably in different groups of birds. In all the Ratitæ, and, amongst the Carinatæ, in the Crypturi, the basipterygoid process springs from the basisphenoid, and not from its rostrum, and articulates with the pterygoid near the quadrate. In most other Carinate birds, wherever it has not been absorbed, it springs from the basisphenoid rostrum; and in most of the Charadriidæ it articulates with the pterygoid near the centre of that bone. In the Gallinæ it is situate still further from the quadrate—so much so, indeed, that in many species the facet which articulates with the pterygoid adjoins the end of the palatine. This character completely breaks down in the Tubinares, and partially so in the Grallæ, as will hereafter be pointed out when these suborders are discussed.

The Sternum.

Although Dr. Parker says (Trans. Zool. Soc. v. p. 227) that the sternum is "the worst part for the systematist to hold by," we may possibly find that it will help us where other characters fail.

The great Gallino-Gralline Order of Birds may be divided into ten suborders, as follows:—

GALLINE.

Crypturi.
Gallinæ.
Pterocletes.
Columbæ.

GRALLINE.

Hemipodii.
Grallæ.
Tubinares.
Gavio-Limicolæ.
Colymbo-Podicipes.
Impennes.

These suborders may be distinguished from each other by the following osteological characters:—

- A. Wing-bones rounded; first digit of manus distinct; scapulars narrow; tarsus long, with the three metatarsals indistinguishable, except at the ends.
  - *a*. Posterior processes of the ilia widely separated, disclosing the broad flat sacrum.
    - a^1. Coracoids without subclavicular processes.
      - a^2. Bifurcation of nasals schizorhinal. CRYPTURI.
      - b^2. Bifurcation of nasals holorhinal . . GALLINÆ.
    - b^1. Coracoids with subclavicular processes.
      - c^2. Dorsal vertebræ heterocœlous.
        - a^3. Bifurcation of nasals schizorhinal.
          - a^4. Basipterygoid processes present, but (to exclude *Grus antigone*, which occasionally possesses them) lateral occipital fontanelles absent.
            - a^5. Basal phalanx of hallux as long as those of other digits. COLUMBÆ.

b^5. Hallux absent, or with basal phalanx shorter than those of other digits.	
a^6. Vomer absent	PTEROCLETES.
a^6. Vomer very broad......	HEMIPODII.
b^4. Basipterygoid processes absent, or (to include *Grus antigone*, which occasionally possesses them) lateral occipital fontanelles present	SCHIZORHINAL GRALLÆ.
b^3. Bifurcation of nasals holorhinal.	
c^1. Horny covering of nostrils not tubular	HOLORHINAL GRALLÆ.
d^1. Horny covering of nostrils tubular	TUBINARES.
d^2. Posterior ends of the dorsal vertebræ, as seen in lateral section, not convex.	
c^3. Basipterygoid processes absent. .	GAVIÆ.
d^3. Basipterygoid processes present.	LIMICOLÆ.
b. Posterior processes of the ilia so closely approximated that a narrow neural ridge is all that they disclose.	
c^1. None of the dorsal vertebræ in front of the sacrum ankylosed..........	COLYMBI.
d^1. Most of the dorsal vertebræ in front of the sacrum ankylosed..........	PODICIPES.
B. Wing-bones flattened; first digit of manus fused with the second in the adult; scapular very broad; tarsus very short, with deep grooves between the metatarsals . .	IMPENNES.

CRYPTURI.

The Tinamous may be regarded as the least-changed descendants of the ancestors of the Gallinæ, and, as such, may be associated with that group in the same Order, in spite of their dromæognathous palates.

They possess the following characters:—

1. In the bifurcation of their nasals they are schizorhinal.

2. The ankylosed sacral vertebræ are preceded by a free vertebra, in front of which are four ankylosed dorsal vertebræ.

3. The coracoids are not furnished with subclavicular processes.

4. The vomer is ankylosed with the maxillo-palatines.

5. They possess basipterygoid processes which spring from the body of the basisphenoid, and articulate with the pterygoids as near the quadrate as possible.

6. In the articulation of their dorsal vertebræ they are heterocœlous.

7. They have never more than one dorsal vertebra in front of the ankylosed sacral vertebræ, which is without a ventral process.

8. The humerus is pneumatic.

The 4th character is diagnostic of the Crypturi, but they are also easily diagnosed by their combination of the 1st and 3rd characters.

The Tinamous divide with the Penguins the honour of being the oldest family in this order. The 3rd, 4th, and 5th characters are all struthious. The sternum is, however, in no respect Ostrich-like. It resembles that of the Phasianidæ in having a well-developed keel, springing from a very narrow median xiphoid process, but differs from it in having the forked and flattened lateral processes represented by a long slender unforked rounded process on each side.

There can be little doubt that the Crypturi are more nearly allied to the Gallinæ than to any other group of birds.

GALLINÆ.

If the Gallinæ be restricted to the three families Phasianidæ, Cracidæ, and Megapodidæ, their diagnosis becomes very simple. They all agree in having the following characters:—

1. In the bifurcation of their nasals they are holorhinal.

2. The ankylosed sacral vertebræ are preceded by a free vertebra, in front of which are four ankylosed dorsal vertebræ.

3. The coracoids are not furnished with subclavicular processes.

4. The basipterygoid processes are always present, and

articulate with the pterygoids, as near the palatines and as far from the quadrates as possible.

5. They are heterocœlous in the articulation of their dorsal vertebræ.

6. The median process of the furculum is much developed.

7. The angle of the mandible is produced and recurved.

The 4th character is diagnostic; and so is the combination of the 1st and 3rd.

The Gallinæ may almost be diagnosed by their peculiar sternum. The median xiphoid process is very long and very narrow; the internal processes are much shorter, and the external processes shorter still. The clefts are so deep that the sternum may be described as all processes.

The Gallinæ appear to be intermediate between the Crypturi and the Pterocletes.

PTEROCLETES.

The Sand Grouse are intermediate between the Columbæ and the Gallinæ. They present the following characters:—

1. In the bifurcation of their nasals they are schizorhinal.

2. The ankylosed sacral vertebræ are preceded by a free vertebra, above which are four ankylosed vertebræ.

3. They possess subclavicular processes.

4. They have no vomer.

5. They possess basipterygoid processes, which spring near the body of the basisphenoid and articulate with the pterygoids as near the quadrate as possible.

6. In the articulation of their dorsal vertebræ they are heterocœlous.

7. The hallux is either very small and elevated, or absent altogether.

The Pterocletes may be diagnosed in a variety of ways. The 4th character is diagnostic; but as the vomer is very small in the Columbæ, it is safer to combine the 7th with it. Equally diagnostic is the combination of the 3rd and 5th; or that of the 1st, 3rd, 6th, and 7th.

The Sand Grouse agree with the Pigeons in the 1st, 2nd, 3rd, and 6th characters; and with the Gallinæ in the 2nd and 6th. They also agree with half the Gallinæ in the 7th character.

The sternum of the Pterocletes very closely resembles that of the Columbæ; the external lateral processes are very short, the outer posterior notches are very deep, and the inner ones small or completely ossified in the adult.

The Pterocletes further resemble the Columbæ in having the humerus pneumatic, and in having no median process to the furculum.

COLUMBÆ.

The Columbæ appear to be so closely connected to the Gallinæ through the Pterocletes, that it seems impossible to exclude them from the Order. The Pigeons are probably more nearly allied to the Sand Grouse than to any other group of birds, although they are born helpless and naked, which is not the case with the Sand Grouse or with any other group of the Order. The Columbæ possess the following characters:—

1. They are heterocœlous in the articulation of their dorsal vertebræ.
2. They are schizorhinal in the bifurcation of their nasals.
3. The basal phalanx of the hallux is as long as that of the middle toes.
4. They are typically Galline in the ankylosis of their dorsal vertebræ.
5. They possess subclavicular processes.
6. They have basipterygoid processes, which articulate with the pterygoids near the middle of those bones.

They may be diagnosed by their combinations of the 2nd and 3rd characters.

If we regard the extinct Dodo as belonging to the Columbæ, the 6th character would break down in this group, inasmuch as there are no basipterygoid processes in the genus *Didus*. It would, however, be unfair to include extinct species in any group, as it is only by the extinction of species that any classification of groups becomes possible.

HEMIPODII.

The Hemipodes resemble the Quails in their general appearance to so great an extent that many ornithologists find a difficulty in overcoming the superstition that they are very closely allied. A comparison of the osteological characters with those of the Gallinæ shows that the Hemipodii differ widely from the Gallinæ, but resemble closely the Schizorhinal Grallæ.

The Hemipodes possess the following characters:—

1. They are heterocœlous in the articulation of their dorsal vertebræ.

2. None of the dorsal vertebræ in front of the ankylosed sacral vertebræ are ankylosed.

3. Only two dorsal vertebræ in front of the ankylosed sacral vertebræ are unfurnished with ventral processes.

4. They are schizorhinal.

5. The coracoids are furnished with subclavicular processes.

6. They possess basipterygoid processes which articulate with the pterygoids nearer the quadrates than the palatines.

7. The humerus is not pneumatic.

8. The vomer is very short, very broad, and truncated in front.

9. The episternum is not perforated to allow the coracoids to touch each other at their bases.

10. The sternum has only one lateral xiphoid process on each side.

The Hemipodii may be diagnosed in various ways, either by their combination of the 1st and 8th characters; or of the 6th and 8th; or of the 2nd, 3rd, 4th, and 6th. They differ from the Gallinæ in no less than eight characters, the 2nd, 4th, 5th, 6th, 7th, 8th, 9th, and 10th. On the other hand they only differ from the Gaviæ and the Grallæ in two characters (from the former in the 1st, from both in the 6th, and from the latter in the 8th), and it is to these suborders that the Hemipodes are nearest allied.

GRALLÆ.

I propose to include in this suborder the Fulicariæ and the

Alectorides of Sclater, which are synonymous with the Geranomorphæ of Huxley. I see no reason why *Opisthocomus* and *Cariama* should not also be included in the Grallæ. The former has been regarded as closely allied to the Cracidæ, and the latter to the Serpentariidæ; but in each case there are at least six facts which are opposed to their supposed affinity, but are consistent with their close relationship to the Grallæ. They appear to be like *Mesites, Eurypygus, Rhinochetus,* and *Psophia,* the scattered remnants of a once large and widespread group, from which the Gruidæ and Rallidæ are also descended.

Opisthocomus differs from the Gallinæ in the following particulars:—

1. It has no basipterygoid processes.
2. It has subclavicular processes.
3. The posterior margin of the sternum is not very deeply cleft.
4. It has very few ventral processes on the dorsal vertebræ.
5. The angle of the mandible is not prolonged and recurved.
6. The episternum is not pierced so as to allow the coracoids to meet at their bases.

In each of these six characters in which it differs from the Gallinæ it agrees with the Otididæ.

Cariama differs from *Serpentarius* in the following particulars:—

1. It is schizognathous.
2. It has no basipterygoid processes.
3. It has subclavicular processes.
4. It has no median process to the furculum.
5. It has lateral processes to the sternum.
6. It has very few ventral processes on the dorsal vertebræ.

In each of these six characters in which it differs from *Serpentarius* it agrees with the Rallidæ.

The following families appear to be sufficiently allied to be associated together in a suborder, to which the name of Grallæ may be applied:—

Opisthocomidæ } Large hallux.*
Mesitidæ . . . . }

Schizorhinal { *Mesitidæ*, *Eurypygidæ*, *Gruidæ*, *Rhinochetidæ*

Gruidæ . . . . . } Lateral occipital fontanelles.
Rhinochetidæ } Long narrow sternum, with no notches.
Psophiidæ . . . . }

Otididæ . . . . No hallux.

Humerus not pneumatic. } *Rallidæ*.

Cariamidæ.

I have been unable to find any satisfactory characters by which the Fulicariæ may be distinguished from the Alectorides; but they may be somewhat unnaturally divided into two groups, the Holorhinal Grallæ and the Schizorhinal Grallæ. The Rallidæ (including *Heliornis*) and the Gruidæ (including *Aramus*) are the typical families of the two sections; but if they be regarded as natural sections, the Otididæ must be removed from the Alectorides to the Fulicariæ, and the Psophiidæ must be placed in a different suborder from the Rhinochetidæ, in spite of the similarity of the sternum. It is quite possible that these changes may be right; but until their propriety be established by other characters, it is probably safest to regard the Grallæ as one suborder, which may be more or less artificially divided into two sections.

The holorhinal Grallæ possess the following characters:—

1. They are heterocœlous in the articulation of their dorsal vertebræ.
2. The posterior processes of the ilia are widely separated.
3. The coracoids are furnished with subclavicular processes.
4. They are holorhinal.

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* *Mesites* and *Opisthocomus* are not only aberrant in having Columbine feet, but the former has no furculum, and the latter has a very remarkable sternum, which looks as if the keel had been turned upside down, the posterior half projecting more than the anterior portion.

5. The horny covering of the nostrils is not tubular.

6. They have no basipterygoid processes.

The schizorhinal Grallæ agree with all these characters except the 4th.

The Grallæ vary exceedingly in the number of ankylosed vertebræ in front of the sacrum, and in the number of dorsal vertebræ which are furnished with ventral processes. Most of them have a small hallux, but the Otididæ have none, and the Opisthocomi and Mesitidæ have a large one, like the Columbæ and some of the Gallinæ (Cracidæ and Megapodidæ).

The 6th character is not a very safe one. I have seen examples of one species of *Grus,* and of more than one species of *Otis,* in which, for some inexplicable reason (if we call it atavism it looks less like accident), the basipterygoid processes have become ossified, instead of being absorbed during the progress from youth to maturity.

The holorhinal Grallæ may be diagnosed by their combination of the 1st, 2nd, 3rd, 4th, and 5th characters. The schizorhinal Grallæ may be diagnosed by the same combination, after the necessary alteration of the 4th character has been made.

If osteological characters have the taxonomic value which they are supposed to possess, the Tubinares appear to be the nearest allies of the Grallæ.

TUBINARES.

The Petrels possess in their tubular nostrils a character which distinguishes them from all their allies; and although this feature is confined to the horny covering of the bill, it simplifies the diagnosis of the group so much, that I have ventured to include it as one of their osteological characters. These are as follows :—

1. The external nostrils are produced into tubes.

2. In the articulation of their dorsal vertebræ they are heterocœlous.

3. In the bifurcation of their nasals they are holorhinal.

4. None of the vertebræ which precede the ankylosed sacral vertebræ are ankylosed.

5. The coracoids are furnished with subclavicular processes.

6. The pelvis is not laterally compressed.

7. The hallux is either absent or consists of only one phalanx.

8. They vary in the number of dorsal vertebræ which are unfurnished with ventral processes, the Oceanitidæ and the Diomedeidæ having three, but the Procellariidæ rarely having any.

Rather more than half the species possess basypterygoid processes, but they are absent in the Diomedeidæ, the Oceanitidæ, and in the genus *Procellaria* and one or two allied genera.

The 1st character is absolutely diagnostic. The combination of the 2nd, 3rd, and 4th characters are diagnostic, except that they do not exclude the Grallæ. The addition to this combination of the 8th character still leaves the Oceanitidæ and Diomedeidæ undistinguished from the Otididæ. It is difficult to avoid coming to the conclusion that the Tubinares are a highly specialized group, nearest related to the once large, now small, group of the Grallæ.

GAVIO-LIMICOLÆ.

I have been unable to find any osteological characters to separate the Gulls from the Plovers, except the presence in the latter, and the absence in the former, of basipterygoid processes. As this character is not constant in the Tubinares, and occasionally breaks down in the Grallæ, it must be received with caution, or at least be regarded as of secondary importance. The Gaviæ are connected with the Limicolæ by a series of intermediate genera : *Dromas* and *Chionis* might be regarded as Gaviæ, and *Glareola*, *Cursorius*, *Pluvianus*, and *Œdicnemus* as Limicolæ, whilst *Thinocorus* might be regarded as an archaic survivor of the common ancestors of both ; but as basipterygoid processes are unknown in any of these genera, if this character be taken as the test, they must all be removed from the Limicolæ to the Gaviæ. It is possible that it would be as consistent to associate the Stone Curlews with the Gulls as the Lapwings with the Avocets. These seven genera further agree with the Laridæ, and differ from the Charadriidæ, in having no lateral occipital fontanelles when adult. Huxley separates the Limicolæ (under the name of the Charadriomorphæ) from the Gaviæ, which he associates with the Tubinares, the Colymbi, and the Podicipes (under the name of Cecomorphæ). Sclater separates the Limicolæ, the Gaviæ, and the Tubinares from each other, but he removes the Alcidæ from the Gaviæ and associates them with the Colymbi and the Podicipes (under the name of Pygopodes). If the articulation of the dorsal vertebræ be an important character, the Alcidæ and the Gaviæ cannot be separated far from each other, nor can the former be associated with the Colymbi or the Podicipes.

As thus restricted, the Gavio-Limicolæ possess the following characters:—

1. The posterior ends of the dorsal vertebræ, as seen in lateral section, are not convex.
2. None of the dorsal vertebræ above the ankylosed sacral vertebræ are ankylosed.
3. The first digit of the manus is present.
4. The pelvis is not laterally compressed.
5. The coracoid is furnished with subclavicular processes.

The combination of the 1st and 3rd of these characters is diagnostic of the group.

In the bifurcation of their nasals the Limicolæ are all schizorhinal; and of the Gaviæ the Laridæ and Alcidæ are all schizorhinal; but the intermediate genera vary in this respect. *Dromas* is typically schizorhinal, *Chionis* and *Glareola* are almost so; the angle is blunter in *Thinocorus*, and well rounded in *Cursorius*, whilst *Pluvianus* and *Œdicnemus* are typically holorhinal.

Although this character, founded on the modification of the bifurcation of the nasals, appears completely to break down in the Gaviæ, its importance in other groups must not be undervalued.

It is impossible to determine the relative importance of osteological characters. In the foregoing key I have given the articulation of the dorsal vertebræ precedence over the bifurcation of the nasals. It is equally probable that the reverse is the proper course. If it were carried out the result would be that the Gruidæ would be transferred from the Grallæ to the Gaviæ, whilst the genera *Œdicnemus* and *Pluvianus* would be transferred from the Gaviæ to the Grallæ. It seems impossible to determine whether the Stone Curlews ought to be removed from the society of the Coursers, and from the anomalous position of being holorhinal birds between the Gulls and the Plovers, both of which are schizorhinal, and be placed under the protection of the Bustards, where they would be in the anomalous position of being opisthocœlous birds between the Bustards and the Trumpeters, both of which are heterocœlous.

COLYMBO-PODICIPES.

It is with profound regret that I confess myself unable to place the Divers in a different suborder from the Grebes. In spite of the difference in their habits and the contrast between their eggs, the osteological differences between the Colymbi and the Podicipes, like those between the Gaviæ and the Limicolæ, appear to be of only secondary importance. On the other hand, the Alcidæ, which are associated by many systematists with the Colymbi and the Podicipes, present many and important osteological differences. An opinion based upon osteological characters alone must be regarded with caution; but osteology appears to teach that the Auks are archaic Gulls, whilst the Grebes and the Divers are highly specialized Penguins.

The Colymbi differ from the Podicipes both in the sternum and in the vertebræ. In the Colymbi all the vertebræ in front of the ankylosed sacral vertebræ are free. In the Podicipes the ankylosed sacral vertebræ are preceded by only one free vertebra, in front of which are four ankylosed dorsal vertebræ. In the Colymbi the median xiphoid process of the sternum is prolonged until it projects beyond the lateral processes, whilst in the Podicipes it is abruptly truncated, so that the lateral processes extend considerably beyond it.

The Colymbo-Podicipes agree together in the following characters:—

1. They are heterocœlous in the articulation of their dorsal vertebræ.

2. The posterior processes of the ilia are approximated to such an extent that the sacrum is almost hidden.

3. The coracoids are furnished with subclavicular processes.

4. They are holorhinal.

5. The hallux is always present, but its basal phalanx is shorter than that of the other toes.

6. All the dorsal vertebræ in front of the ankylosed sacral vertebræ have ventral processes.

7. The humerus is not pneumatic.

8. They have no basipterygoid processes.

9. The cnemial process of the tibia is remarkably developed.

The 2nd and 9th characters are equally diagnostic of the Colymbo-Podicipes. They differ from the Alcidæ in the 1st, 2nd, 4th, and 9th characters.

IMPENNES.

The Penguins are regarded by many ornithologists as more archaic than the Tinamous, but the arrangement of the bones of the palate is so precisely that of a Bustard or a Gull, that it is impossible to accept such a conclusion. It is true that none of the feathers of the wing are differentiated into quills, and that many of their osteological characters are diagnostic, but it is not difficult to suggest a cause for these facts. The quills of the wings of the *Apteryx* may be slowly dying out by *degradation by disuse*, whilst those of the Penguins may have rapidly disappeared by *differentiation by use for another purpose*. It is much more difficult to suggest the nearest allies of the Penguins:—

1. They are not heterocœlous in the articulation of their dorsal vertebræ*.

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* The Penguins are more opisthocœlous than any other group in the Order. The dorsal vertebræ are not only posteriorly concave, but they are anteriorly convex, and in both cases the description applies as much to the vertical as to the lateral section.

2. None of the dorsal vertebræ in front of the sacrum are ankylosed.

3. The posterior processes of the ilia are widely separated.

4. The coracoids are furnished with subclavicular processes.

5. They are holorhinal.

6. The hallux is always present, but its basal phalanx is shorter than that of the other toes.

7. All the dorsal vertebræ in front of the ankylosed sacral vertebræ have ventral processes.

8. The humerus is not pneumatic.

9. They have no basipterygoid processes.

10. The first digit of the manus is fused with the second in the adult.

11. The three metatarsal bones of the tarso-metatarsus are very short, and are separated from each other throughout their whole length by deep grooves.

12. The bones of the forearm are all flattened.

13. The scapula is very broad, not differing very much in size from the keel of the sternum.

Not only are the 10th, 11th, 12th, and 13th characters each of them diagnostic, but the combination of the 1st, 5th, and 6th is so also.

The Colymbi agree with the Impennes in more of these characters than any other group does, and may possibly be their nearest allies.

XLIV.—*Note on the Genus* Rectes. By R. Bowdler Sharpe, F.L.S., F.Z.S., &c.

Dr. A. B. Meyer has kindly lent me a series of skins of *Rectes*, from New Guinea, along with the types of some of his new species. In 1877, when I completed the third volume of the 'Catalogue of Birds in the British Museum,' I admitted four species of *Rectes* with a cap, viz.:—

1. *R. cirrhocephalus* (=juv.), *R. dichrous* (=ad.).
2. *R. uropygialis*.
3. *R. tibialis*.
4. *R. aruensis*.